CLAIMS

1. An architecture of an ignition management system for an internal combustion engine, adapted to cooperate with an electronic engine control unit, the architecture comprising:

a first module structured to process electric signals from which the angular position of the engine driving shaft can be obtained;

a second module structured to process electric signals from which the cycle phase of the engine can be obtained;

a third module structured to supply suitable signals for driving the injectors so as to actuate the desired injection profile stored inside the module; and

a fourth module structured to enable the module and to receive signals from the first and second modules and from the fourth module itself.

2. The architecture according to claim 1 wherein the first module is input a signal from a sensor of a phonic wheel made rotatively rigid with the engine driving shaft.

3. The architecture according to claim 1 wherein the second module is input a signal from a sensor of a phonic wheel made rotatively rigid with the engine camshaft.

4. The architecture according to claim 1 wherein the third module is input a pair of signals from the second module, said signal pair relating to the engine cycle phase and to the number of teeth of the phonic wheel, and an additional signal from the first module, the additional signal relating to the angular position of the engine driving shaft.

5. The architecture according to claim 1 wherein the fourth enabling module is input a first signal relating to the angular position of the engine driving shaft, a second signal relating to the cycle phase of the engine, and a third signal indicating the operational state of the third module.

6. The architecture according to claim 2 wherein the phonic wheel has a predetermined number of equidistant teeth arranged on the circumference, a small group of adjoining teeth being missing to define a reference point on the wheel detectable by the sensor.

7. The architecture according to claim 6 wherein the number of teeth of the phonic wheel and the number of missing teeth are programmable.

8. The architecture according to claim 1 wherein the first, second and third modules are structurally and functionally independent.

9. The architecture according to claim 3 wherein the second module is input a signal of a teeth counter of the driving shaft phonic wheel from the first module, and that a predetermined amount of phase displacement may be provided between said signal and the signal from the sensor associated with the camshaft in order to control the cycle phase of variable timing engines.

10. The architecture according to claim 1 wherein the fourth module is a logic network.

11. The architecture according to claim 3 wherein the phonic wheel has a non-standard arrangement of teeth along its circumference.

12. The architecture according to claim 3 wherein the module may be programmed so as to be adapted to different camshaft phonic wheels.

13. The architecture according to claims 11 wherein the module may be programmed so as to be adapted to different camshaft phonic wheels.

14. An electronic device for determining the operating phase of an internal combustion motor, the device being of the type structured to cooperate with an electronic motor control unit and inputting a signal issued from a sensor of a phonic wheel associated with the motor camshaft, the device comprising:

a first I/O interface module incorporating a plurality of registers and receiving signals from the electronic motor control unit;

a second module connected bi-directionally to the first module and inputting the signal issued from said sensor to identify a camshaft reference and to supply the operating phase of the motor;

a third module adapted to issue an interrupt signal toward the unit electronic engine control unit according to an error signal incoming from the second module.

15. The device according to claim 14 wherein the registers of the first module can be accessed both while reading and writing from the electronic engine control unit via a standard interface.

16. The device according to claim 14 wherein the search for the reference and the following calculation of the camshaft position are carried out in the second module by continually monitoring the signal from the sensor of the camshaft phonic wheel.

17. The device according to claim 14 wherein a second set of registers, inside the first module, contain data about the internal state and the results of the second module.

18. The device according to claim 14 wherein once an interrupt signal is generated, a relevant internal register of the first module is also updated, from which the type of error caused by the second module can be found.

19. The device according to claim 14 wherein the registers included in the first module are:

start	Starts the state machine implemented in "cams_shaft"
Stop	Stops the state machine implemented in "cams_shaft" and brings it back to its initial state ready to start again.
mem_cam_changes1	Table of *size1* items, containing the number-of-tooth values of the driving shaft phonic wheel where transitions occur on the cam signal during the driving shaft rotation corresponding to phase zero.
profile1	Indicates the expected value of the cam profile stored in *mem_cam_changes1*.
size1	Indicates the number of items stored in the *mem_cam_changes1* and *profile1* tables.
mem_cam_changes2	Table of *size1* items, containing the number-of-tooth values of the driving shaft phonic wheel where transitions occur on the cam signal during the driving shaft rotation corresponding to phase one.

profile2	Indicates the expected value of the cam profile stored in *mem_cam_changes2.*
size2	Indicates the number of items stored in the *mem_cam_changes2* and *profile2* tables.
mem_cam_r	Table of *sizer* items, containing the number-of-tooth values of the driving shaft phonic wheel where transitions occur for the reconstructed cam signal.
Profiler	Indicates the expected value of the cam profile stored in *mem_cam_r.*
Sizer	Indicates the number of items stored in the *mem_cam_r* and *profiler1* tables.
Delta	Indicates the width of the interval around the time point when the system is expecting a tooth of the camshaft phonic wheel.
offset_out	Indicates the extent that the cam signal has to be shifted from the driving shaft phonic wheel signal.
a_ns	Indicates whether the shift has to occur in the forward or the backward direction.
cfg_phase	Indicates if the teeth counter of the driving shaft phonic wheel has to be shifted.

20. The device according to claim 19 wherein the second set of registers of the first module is updated by the second module are the following:

error_at	Indicates the number of the tooth where the last error occurred.
teeth_cnt	Indicates the driving shaft angular position as phonic wheel teeth counter from 1 to 2* (n_tooth_holes).

cam_phase	Indicates the motor phase.
lock_cam	Indicates that the motor operating phase is found.
stato_out	Indicates the current state of the "cams_shaft" state machine.
rec_out	Desired camshaft profile.

21. The device according to claim 14 wherein the second module constantly checks the pulses of the signal from the sensor, and it evolves according to a state machine on the basis of a table correlating the profile of a driving shaft phonic wheel with the camshaft phonic wheel.

22. The device according to claim 21 wherein the format of the correlation table is the following:

Phase 0		Phase 1	
mem_cam_changes1	profile1	mem-cam_changes2	Profile2
2	1	14	1
3	0	15	0
		16	1
		17	0

and includes a firs table for Phase 0, containing the transitions of the signal during the first rotation of the driving shaft, and a table for Phase 1 containing the transitions of the signal during the second rotation of the driving shaft.

23. An architecture of an electronic device for determining the angular position of a driving shaft in internal combustion engines, the architecture being of the type intended to cooperate with an engine electronic control unit and receiving an input

signal emitted by a sensor of a tone wheel associated to the driving shaft, the architecture comprising:

a first I/O interface module embedding a plurality of registers and receiving signals from the electronic engine control unit;

a second module bi-directionally connected to the first module and receiving the input signal emitted by the sensor to detect a reference on the driving shaft and provide its angular position moment by moment;

a third module capable of emitting an interrupt signal toward the electronic engine control unit on the basis of an error signal received from the second module.

24. The architecture according to claim 23 wherein the registers of the first module can be accessed in reading and writing mode by the electronic engine control unit via a standard interface.

25. The architecture according to claim 23 wherein in the second module the search of the reference and the subsequent calculation of the driving shaft position occur by constantly monitoring the signal transmitted by the sensor of the tone wheel.

26. The architecture according to claim 23 wherein a second set of registers internal to the first module contains data relating to the internal status and the results of the second module.

27. The architecture according to claim 23 wherein the generation of an interrupt signal also updates a related register internal to the first module from which it is possible to trace the type of error generated by the second module.

28. The architecture according to claim 23 wherein the registers embedded in the first module are:

start	Starts the state machine implemented in "fsm_fonica".
Stop	Stops the state machine implemented in "fsm_fonica" restoring its original status waiting for a new start-up.
Overflow	Sets the waiting time limit so that the lack of teeth in this time interval indicates a system error status.
num_of_teeth	This indicates the tone wheel number of teeth.
num_of_holes	This indicates the tone wheel number of holes.
num_of_check	This indicates the number of revolutions of the driving shaft to be waited after the lock before passing to the injection phase.
Delta	This indicates the extent of the interval around the time instant in which the system expects a tone wheel tooth.
cfg_filter	Enables or disables the digital filter to be applied on the signal transmitted by the tone wheel.
cfg_check	This indicates whether it is necessary to reset, in case of error, the count of already executed checks.
error_at	This indicates the number of tooth where the last error occurred.
Tooth_num	This indicates the current number of tooth of the tone wheel.

i_teeth	This indicates an intermediate position between two adjacent teeth of the same tone wheel with a fixed accuracy.
Frt	Free running timer.
Stato_out	This indicates the current status of the state machine of the "fsm_fonica".
Diffdente_out	This indicates a value from which it is possible to trace the revolution speed of the driving shaft with the following expression: $rpm = \frac{f * 60}{n\_tooth\_holes * diffdente\_out}$ where f is the system clock frequency (clk).
Pending	This indicates the type of error occurred.

29. The architecture according to claim 25 wherein the second module checks that every subsequent pulse of the signal occurs within a fixed temporal window or that no pulse is received within said window to pass through the tone wheel point of reference search status.

30. The architecture according to claim 29 wherein the temporal window is determined as difference (*count2* - *count1*) between the subsequent instants of reception of the signal (fonica_signal), also determining the center of an interval in which the next pulse is expected; the extent of the interval being calculated as ratio (*count2* – *count1*) / *n*, with *n* equal to the number of teeth of the tone wheel.

31. An architecture of a system for driving the injection and/or ignition in internal combustion engines, of the type intended to cooperate with an engine electronic control unit by driving corresponding injection drivers, and comprising:

a first I/O interface module embedding a plurality of registers and receiving signals from the engine electronic engine control unit;

a second module bi-directionally connected to the first module from which it receives information at least on the injection times and the quantity of fuel to be injected for generating driving signals for the injection drivers, thereby actuating a desired injection profile;

a third module capable of emitting an interrupt signal toward the electronic engine control unit on the basis of signals received by the second module.

32. The architecture according to claim 31 wherein the registers of the first module can be accessed in writing and reading mode from the ECU by a standard interface.

33. The architecture according to claim 31 wherein the registers embedded in the first module are:

start	Its status is reported by the output "start_dec"
Stop	Stops the state machine implemented in "inj" restoring its original status waiting for a new start.
presc_conf	Prescaler of the timer internal to module "inj"
Period	Period of the PWM signals to be generated
duty_high	Table containing a set of duty-cycle values of the PWM signals to be generated
Security	This indicates if the security condition is enabled
compare_value	Watchdog value

time_diag	This indicates the instants in which diagnostics should be carried out
cfg_diag	This indicates if diagnostics should be carried out
Index_diag	This indicates the element of the *time_diag* signal to be used for diagnostics
expected_diag	This indicates the value expected from the diagnostic check
cfg_diag_sec	This indicates whether diagnostics should be carried out in security condition
Index_diag_sec	This indicates the element of the *time_diag* signal to be used for diagnostics in security condition
expected_diag_sec	This indicates the value expected from the diagnostic check in security condition
time_prof	Table containing the instants of variation of the injection profile
Profile	Table containing the configuration values of signals **curr_out** and **pwm_out** for every instant of variation of the injection profile
cfg_time_prof	This indicates whether the actuation of the injection profile should be based on time or angles
cam_phase_conf	This indicates the phase in which injection should be carried out
num_shape	Number of shapes forming the injection profile
time_prof_sec	Table similar to **time_prof** but valid in security condition
profile_sec	Table similar to **profile** but valid in security condition

cfg_time_prof_sec	This indicates whether the actuation of the injection profile in security condition should be based on time or angles
cam_phase_conf_sec	This indicates the phase in which injection should be carried out in security condition
num_shape_sec	Number of shapes forming the injection profile in security condition
Output to **"pend_inj"**	
Mask	Interrupt mask
Input from **"inj"**	
stato_out	This allows to trace the "inj" state
cfg_pwm	This indicates the current configuration of module "pwm_inj"
curr_out	This indicates the current configuration of the steady driver driving signals
Input from **"pend_inj"**	
Pending	This indicates the type of error occurred

34. The architecture according to claim 31 wherein the second module directly receives an input signal relating to the engine phase, and a further pair of signals related to the angular position of the drive shaft.

35. The architecture according to claim 31 wherein when an interrupt signal is generated a relevant internal register of the first module is also updated from which it is possible to trace the type of error generated by the second module.

36. The architecture according to claim 31 wherein the second module comprises a main block for driving the injection drivers and an auxiliary block adapted

for generating PWM signals through configuration commands provided by the main block.

37. The architecture according to claim 36 wherein the auxiliary block is in charge of generating both a square wave with the desired duty-cycle and of obtaining either a high or a low logical value in output.

38. The architecture according to claim 37 wherein the main block operates in two modes by using a corresponding set of data in the registers; one of said modes being a security mode for which the set of data taken into consideration is as follows:

time_prof_sec	Table similar to **time_prof** but valid in security condition
profile_sec	Table similar to **profile** but valid in security condition
cfg_time_prof_sec	This indicates whether the actuation of the injection profile in security condition should be based on time or angles
cam_phase_conf_sec	This indicates the phase in which injection should be carried out in security condition
num_shape_sec	Number of shapes forming the injection profile in security condition